

Associate Higgs boson production with a decay into a tau pair in the CMS experiment

Thanks of its mass, the tau lepton has a non-negligible coupling to the Higgs boson, thus allowing the $H \rightarrow \tau\tau$ decay channel to be used in the context of the search of the Higgs boson. This channel is particularly relevant if the Higgs boson mass lies in the low mass range ($M_H < 135 \text{ GeV}/c^2$) as favored by the global fit of the electroweak sector and the latest results from the LHC experiments.

Two associate Higgs boson production modes are envisioned for this thesis: the so-called vector-boson fusion (VBF) mode is characterized by two jets without color-exchange while in the “Higgs-strahlung” production, the Higgs boson is produced together with a W or Z boson. The cross sections of the two processes are of the same order of magnitude at low mass. The former is nevertheless more suited for the discovery period and will be studied first while the latter requires more integrated luminosity but gives direct access to the VVH couplings which are tightly connected to the symmetry breaking mechanism.

The work will be carried out within the H in 2 tau group in which the CMS Team at the LLR is already strongly involved for the VBF H channel. The thesis will include an algorithm part on the particle-flow event reconstruction, which is the fundamental tool for the tau reconstruction in CMS. The improvement of the particle-flow event reconstruction in a high pile-up event multiplicity environment will be studied, and ported at the High Level Trigger.

The internship and the thesis will be conducted at the LLR with frequent stays at CERN.

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